

REMARKS

Claims 1-9 are pending herein.

I. The objections to the claims.

Applicants respectfully thank the Examiner for the suggestions, which have been implemented.

II. The obviousness rejections of claims 1 and 3 based on Cabral (US 2006/0138603) in view of Doh (US 2006/0115993) as noted on page 3 of the Office Action.

The USPTO respectfully rejects claims 1 and 3 under 35 U.S.C. § 103(a) as being unpatentable over Cabral and Doh. Claim 1 is an independent claim.

A. The cited references do not teach or suggest that a diffusion suppression layer comprises a high-k metal element different from a metal constitutional element of the high dielectric constant insulating film, as claimed in claim 1.

Claim 1 claims in relevant part:

“wherein the diffusion suppression layer comprises nitrogen and a high-k metal element different from a metal constitutional element of the high dielectric constant insulating film.” (emphasis added)

No new matter is added by the amendments. Support for the amendments is found in present Figure 1 and page 5, line 16 through page 6, line 8 of the present specification. Regarding these limitations, it is respectfully not seen where the cited references teach or suggest the claimed structure quoted above.

For example, on page 3 of the Office Action, the USPTO respectfully notes that Cabral does not teach a diffusion suppressing layer provided on the interface layer. Thus, regarding the amendment, it respectfully follows that Cabral cannot teach or suggest that a diffusion suppression layer comprises nitrogen and a high-k metal element different from a metal constitutional element of the high dielectric constant insulating film. The USPTO respectfully attempts to overcome this deficiency in Cabral by citing paragraphs [0006]-[0009] of Doh.

However, paragraphs [0006]-[0009] of Doh explain that the purported diffusion suppression layer is formed by nitriding a silicon substrate upon which the high dielectric layer is formed. Thus, paragraphs [0006]-[0009] necessarily requires that **the purported diffusion**

suppression layer of Doh will have the same metal constitutional as the high dielectric layer from which it is formed. For example, in Doh, the metal constitutional element of the high dielectric layer before nitriding can be one of Al, Hf, or Zr. After the nitriding treatment, **the metal constitutional element of the purported diffusion suppression layer is still the same element of Al, Hf, or Zr that was in the high dielectric layer before nitriding.**

Thus, Doh respectfully cannot teach or suggest that a diffusion suppression layer comprises a high-k metal element different from a metal constitutional element of the high dielectric constant insulating film, as claimed in claim 1.

In contrast, present Figure 1 illustrates at least one possible embodiment of the claimed structure quoted above. For example, present Figure 1 shows a diffusion suppressing film 6 and a high dielectric constant insulating film 7. As explained on page 5, lines 16-19 of the present specification, diffusion suppressing film 6 can be formed of AlN or AlO_xN_y. In other words, **the high-k metal element of the diffusion suppressing film 6 is Al.** As explained at page 6, lines 2-3 of the present specification, high-k film 7 is formed of HfO₂. In other words, **the metal constitutional element of the high-k film 7 is Hf.** Thus, diffusion suppression layer 6 comprises a high-k metal element (Al) different from a metal constitutional element (Hf) of the high dielectric constant insulating film, as claimed in claim 1.

The distinction noted above is important and non-trivial because it results in significant advantages over conventional devices. For example, as noted on page 8 of the present specification, the specifically claimed diffusion suppressing layer of claim 1 allows for suppression of oxygen diffusion from the inside of high dielectric constant insulating film to the interface layer, **thus preventing impairment of high-dielectric characteristics.**

Thus, it is respectfully asserted that the cited references, taken either alone or in combination, do not teach or suggest all of the limitations of independent claim 1. Therefore, it is respectfully asserted that independent claim 1 is allowable over the cited references.

B. The dependent claims.

As noted above, it is respectfully asserted that independent claim 1 is allowable, and therefore it is further respectfully asserted that dependent claim 3 is also allowable.

III. The obviousness rejections of claims 2 and 6 based on Cabral in view of Doh and Bai (US 2001/0013629), as noted on page 8 of the Office Action.

As noted above, it is respectfully asserted that independent claim 1 is allowable, and it is further respectfully asserted that Bai does not overcome the deficiencies in Cabral and Doh as noted above in Section II regarding independent claim 1. Therefore, it is further respectfully asserted that dependent claims 2 and 6 are also allowable.

IV. The obviousness rejections of claims 4-5 based on Ma (US 2002/0130340) in view of Harada (US 2002/0195643), as noted on page 6 of the Office Action.

The USPTO respectfully rejects claims 4-5 under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Harada.

The cited references do not teach or suggest forming an initial layer which is a high dielectric constant metal element film on one surface of a silicon substrate, as claimed in claims 4 and 5.

Claim 4 claims in relevant part:

“forming, **on one surface of a silicon substrate, an initial layer which is a high dielectric constant metal element film** for being mutually diffused with silicon in the silicon substrate;

forming a diffusion suppressing layer on the surface of the initial layer.”
(emphasis added)

Claim 5 claims similar limitations. No new matter is added by the amendments. Support for the amendments is found in present Figure 1 and page 5, line 16 through page 6, line 8 of the present specification. Regarding these limitations, it is respectfully not seen where the cited references teach or suggest the claimed structure quoted above.

For example, the USPTO respectfully argues on page 7 of the Office Action that Ma teaches forming an initial layer 140 on one surface of the silicon substrate, based on the description at paragraph [0034] of Ma that it is possible to reverse the order of the materials such that high-k layer 140 would be deposited prior to interposing layer 130. However, it is respectfully important to note in paragraph [0036] of Ma that **if high-k layer 140 would otherwise be in contact with the underlying silicon substrate, an oxidation barrier 170 is provided between semiconductor substrate 112 and multilayer dielectric stack 116.** In other words, if high-k layer 140 is formed before interposing layer 130 in Ma, high-k layer 140 is not formed on the underlying silicon. Instead, **an oxidation barrier 170 is**

provided between the underlying silicon and high-k layer 140 of Ma. Thus, it is respectfully asserted that high-k layer 140 of Ma cannot be an initial layer which is a high dielectric constant metal element film on one surface of a silicon substrate, as claimed in claims 4-5.

Additionally, Harada respectfully does not overcome these deficiencies in the primary reference Ma. For example, Harada is only respectfully cited as teaching a metal film mutually diffusing with silicon to form a metal silicate, and does not teach or suggest anything regarding forming an initial layer which is a high dielectric constant metal element film on one surface of a silicon substrate, as claimed in claims 4 and 5.

In contrast, present Figure 2(a) illustrates at least one possible embodiment of the claimed structure quoted above. For example, present Figure 2(a) shows **an interface layer 5' formed on one surface of a silicon substrate 2.** Page 5, lines 9-15 of the present specification explain that **initial layer 5' can be a thin film comprising HfO₂.** In other words, present Figure 2(a) shows forming an initial layer which is a high dielectric constant metal element film on one surface of a silicon substrate, as claimed in claims 4 and 5.

The distinction noted above is important and non-trivial because it results in significant advantages over conventional devices. For example, as noted on page 8 of the present specification, the specifically claimed diffusion suppressing layer of claim 1 allows for suppression of oxygen diffusion from the inside of high dielectric constant insulating film to the interface layer, **thus preventing impairment of high-dielectric characteristics.**

Thus, it is respectfully asserted that the cited references, taken either alone or in combination, do not teach or suggest all of the limitations of claims 4 and 5. Therefore, it is respectfully asserted that claims 4 and 5 are allowable over the cited references.

V. New Claims 7-9.

Applicants respectfully note that new claims 7-9 have been added. No new matter is added by the new claims. Support for the new claims is found at page 6, lines 21-30 of the present specification.

VI. Conclusion.

Reconsideration and allowance of all of the claims is respectfully requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Please contact the undersigned for any reason. Applicants seek to cooperate with the Examiner including via telephone if convenient for the Examiner.

Respectfully submitted,

By: / Daniel P. Lent/
Daniel P. Lent
Registration No. 44,867

Date: January 14, 2010
CANTOR COLBURN LLP
20 Church Street
22nd floor
Hartford, CT 06103-3207
Telephone (860) 286-2929
Facsimile (860) 286-0115
Customer No.: 23413